REMARKS

This amendment is responsive to the Office Action of November 8, 2007. Claims 1-18 and 20 have been amended herein. Figure 6 has been amended as shown in the attached replacement sheet. Reconsideration and allowance of claims 1-33 are requested.

The Office Action

The drawings were objected to under 37 C.F.R. 1.83(a) because they fail to show subject matter as described in the Specification.

Claims 1-18 were objected to under 37 C.F.R. 1.75(a) as failing to conform to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Claim 7 was objected to under 37 C.F.R. 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim.

Claims 1-5, 7 and 10-16 were rejected under 35 U.S.C. 102(b) as being anticipated by Bani-Hashemi *et al.* (U.S. 5,690,106).

Claims 6 and 8 were rejected under 35 U.S.C. 103(a) as being unpatentable over Bani-Hashemi *et al.* in view of Tom *et al.* (Motion Estimation of Skeltonized Angiographic Images Using Elastic Registration, IEEE Transactions on Medical Imaging, Vol. 13, No. 3, 11/1994, pg. 450-460).

Claims 9 and 17-18 were rejected under 35 U.S.C. 103(a) as being unpatentable over Bani-Hashemi *et al.* in view of Levin (U.S. 5,546,472).

Claims 19-33 do not stand rejected and are understood to contain allowable subject matter.

Objection to Drawings Under 37 C.F.R. 1.83(a)

Figure 6 has been amended in accordance with the Examiner's helpful suggestion. A replacement sheet is submitted herewith in accordance with 37 C.F.R. 121(d).

Objection to Claims 1-18 Under 37 C.F.R. 1.75(a)

Claims 1-18 have been amended in accordance with Examiner's helpful suggestions. Applicants' representative thanks the Examiner for the suggestions. Thus, it is respectfully requested that this objection be withdrawn with respect to **claims 1-18**.

Objection to Claim 7 Under 37 C.F.R. 1.75(c)

Claim 7 has been amended in accordance with the Examiner's helpful suggestions. Applicants' representative thanks the Examiner for the suggestions. Thus, it is respectfully requested that this objection be withdrawn with respect to **claim 7**.

The Present Application

Some imaging modalities, like PET and SPECT, have relatively long data acquisition times as compared to basic physiological cycles such as the respiratory cycle or the cardiac cycle. Consequently, these images are motion artifacted.

Another drawback of PET or SPECT imaging is that the images are limited to images of the radio pharmaceutical. In one common PET or SPECT imaging technique, the radio pharmaceutical is carried by the blood and the image is an image of the vascular system. However, because the image is only of the vascular system without the surrounding tissue, it can be difficult to interpret and relate to the patient's anatomy.

Other imaging techniques such as CT or MRI can be used to generate anatomical images in one or more individual states of motion.

The single state CT or MR images are interpolated or extrapolated into a motion model for the range of motion through which the patient moves during the collection of the SPECT or PET data. Using the CT or MRI images and the motion model, images can be generated of any motion state within the range of motion. These images can be combined with the SPECT or PET data in any of a variety of ways.

For example, PET or SPECT projections which span only a single or small range of states of motion can be combined with projections of MRI or CT data in a similar state or small range of states to create a projection showing the patient's anatomy with the blood vessel map highlighted. These projections can then be combined into an appropriate end image.

In another example, the CT or MRI images and the motion model can be used to generate a series of images in each of the states of motion in the range of motion undergone during the acquisition of the PET or SPECT data. These images can be weighted in accordance with the amount of time which the patient spent in each state of motion during the acquisition of the PET or SPECT data and combined to generate an anatomical image with the same image artifacts as the PET or SPECT image. The like motion artifacted anatomical image and the SPECT or PET image can then be combined.

Numerous other applications are also described in the present application.

The References of Record

Bani-Hashemi *et al.* is directed to a different technique which is utilized in a different way to achieve different end results. Specifically, Bani-Hashemi *et al.* is directed to a registration technique. Note, in the present application, in the discussion concerning R2 of Figure 1, before two images are combined, the two images are registered or brought into physical alignment. Bani-Hashemi *et al.* is directed to a technique for registering or bringing two images into alignment.

Bani-Hashemi *et al.* assumes that the reader has a significant amount of background knowledge using angiographic imaging utilizing a C-arm x-ray source and detector. Bani-Hashemi *et al.* generates a stack of planar images using the C-arm x-ray device. If one moves the x-ray source and the x-ray detector back and forth in opposite directions along horizontal parallel lines on opposite sides of the patient, the x-ray trajectories between the x-ray source and the detector will rock about a single plane mid-way between the two. With every sampling, data from within that plane becomes reinforced while data outside that plane becomes a blur or average of radiation attenuation over different tissue types. In this way, an image of a single

slice is generated. By shifting the relative vertical position of the x-ray source and detector, each slice of the stack can be generated. However, when more sophisticated mathematics are utilized, the x-ray source and detector can be moved in non-parallel lines, e.g., rocked back and forth about the pivot point of the C-arm. Moreover, using the more sophisticated math and by rebinning and reorganizing the rays of data, all of the data for generating the stack of planar images can be generated.

As can be imagined, as compared to a CT scanner, the images generated by the C-arm x-ray source are a bit crude. The data is generated over a limited arc. Moreover, the C-arm is a large, heavy structure and there is play during its movement, rendering reproducibility elusive.

On the other hand, C-arm x-ray devices are much cheaper than a CT scanner. Moreover, C-arm x-ray systems are very flexible and can be utilized for a very large number of very diverse x-ray based examinations.

Bani-Hashemi *et al.* is concerned with digital subtraction angiography. Digital subtraction angiography is often done in the patient's legs. More specifically, the C-arm assembly is moved to each of four or five stations along the legs and operated to generate a stack of images at each station.

In digital angiography, the C-arm is moved to generate two stacks of images at each station, one with contrast agent and another or mask image without the contrast agent. As can be appreciated, all of this moving from station to station and rocking the C-arm at each station renders it highly unlikely that the mask and contrast agent images will be aligned.

Bani-Hashemi *et al.* describes a technique for registering the contrast and mask images. Specifically, Bani-Hashemi *et al.* takes a first derivative of the corresponding mask and contrast images to generate a pair of images which are merely the outlines of veins and other structures. Next, he chooses several subareas or tiles of one of the images and compares it with subareas of the other image to find the corresponding tile location and orientation. He then determines the transform, i.e., translation, in-plane rotation, and magnification needed to overlay one tile on the corresponding area of the other image. It might be noted that if the tiles are exactly aligned in both images, there would be zero translation, zero rotation, and zero magnification. Rather than determining the transform for every subregion,

Bani-Hashemi *et al.* takes a plurality of subregions of each planar image, determines the transform for each of the subareas, and interpolates the transforms for areas between the actually checked subareas. Once the mask or contrast image has been transformed into registration or alignment with the other image, the two planes can be subtracted to generate an angiogram or map of the patient's blood vessels.

In brief summary, Bani-Hashemi *et al.* is directed to a technique for registering or bringing a planar contrast image and an planar mask image into alignment prior to subtracting the two images. No motion model is generated, no intermediate images are generated, and no intermediate images are combined with either the contrast or mask image.

Tom *et al.* appears to disclose an approach for estimating the motion of arteries in digital angiographic image sequences.

Levin appears to illustrate obtaining an image from an object by acquiring training signal measurements and deriving a set of basis functions that provide a convergent series expansion of the images.

The Claims Distinguish Patentably Over the References of Record

Independent **claim 1** recites ***determining a motion model which characterizes states of motion assumed by the object*** *while moving through the states of motion.* Bani-Hashemi *et al.* fails to disclose or suggest the claimed subject matter.

The cited reference relates to acquiring two sets of images (a mask and contrast series) from a stationary object. The two sets of images are acquired by rotational imaging of the stationary object. The mask images are subtracted from the contrast series to provide an angiogram (more specifically, depicting the blood vessels with the contrast agent). Examiner contends that Bani-Hashemi *et al.* discloses the claimed subject matter at col. 4, ll. 25-26 (*See* Office Action dated November 8, 2007, pg. 7). Applicant's representative avers to the contrary.

The cited reference acquires images from a *stationary object.* Since the object is not moving in the cited reference, a motion model is not created by Bani-Hashemi *et al.* and no state of motion is characterized; therefore, the cited reference fails to disclose or suggest ***determining a motion model which***

characterizes states of motion assumed by the object as recited by independent claim 1.

Furthermore, Bani-Hashemi *et al.* fails to disclose or suggest ***forming an intermediate image of the object from the motion model and the second modality images****, the intermediate image representing the object as if it had moved over the range of motion over which the object moved as the first modality data was acquired,* as independent claim 1 recites. Examiner contends that the cited reference discloses this claimed feature by computing geometrically corrected mask data that is derived from interpolation. Applicants' representative respectfully disagrees with such contention.

The cited reference does not form an intermediate image of the object from a motion model and the further images. Instead, the cited reference appears to disclose forming a set of images from the two existing sets of images, and does not employ a motion model or any equivalent in conjunction with the two sets of images. Thus, Bani-Hashemi *et al.* does not disclose or suggest ***forming an intermediate image of the object from the motion model and the second modality images***.

Claim 2 recites ***determining a motion model which*** characterizes ***states of motion assumed by the object***. Independent claim 3 recites a similar feature. Examiner contends that W^n is a motion model (*See* Office Action dated November 8, 2007, pg. 7). Applicant's representative respectfully disagrees with such contention.

The cited reference, as noted *supra*, does not disclose or suggest any such moving object. Therefore, no motion model can be computed by the cited reference. Furthermore, the cited reference fails to disclose that W^n is derived from the contrast and mask sequences, or that W^n characterizes states of motion. Therefore, Bani-Hashemi *et al.* fails to disclose or suggest ***determining a motion model which characterizes states of motion assumed by the object***.

Applicant's representative reminds Examiner that the standard for determining anticipation is ***strict identity***. Anticipation requires that ***each and every element*** of the subject claim appear in a single reference, and that the elements appear in the reference ***in the same order*** as in the claim (*See* Levi Strauss & Co. v. Golden Trade, S.r.L., 1995 WL 710822 *30 (S.D. N.Y. 1995)). A critical analysis of the cited

reference leads to the determination that neither of these standards are met, and as a result, the subject claims are not anticipated.

In view of the foregoing, it is readily apparent that the cited reference fails to anticipate independent claims 1-3 or claims 4-18 dependent therefrom. Therefore, it is respectfully requested that this rejection be withdrawn with respect to all claims.

Examiner contends that **claims 6 and 8** are rendered obvious over Bani-Hashemi *et al.* in combination with Tom *et al.* This rejection should be withdrawn for at least the following reasons. Claims 6 and 8 depend from claims 1 and 2, respectively, and Tom *et al.* fails to make up for the aforementioned deficiencies of Bani-Hashemi *et al.* with respect to the subject claims. Therefore, it is respectfully requested that this rejection be withdrawn.

Additionally, Examiner contends that **claims 9 and 17-18** are rendered obvious over Bani-Hashemi *et al.* in combination with Levin. This rejection should be withdrawn for at least the following reasons. Claims 9 and 17-18 depend from claims 1-3; Levin fails to make up for the aforementioned deficiencies of Bani-Hashemi *et al.* with respect to independent claims 1-3. Therefore, it is respectfully requested that this rejection be withdrawn.

No action has yet been received on **claims 19-33** even though these claims were filed prior to the November 8, 2007 Office Action.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-33 (all claims) distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas E. Kocovsky, Jr. at (216) 861-5582.

Respectfully submitted,

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